***Competency* 2.9** **EH Residents shall demonstrate a familiarity level knowledge of the requirements for radiation protection in the following regulation and Department of Energy (DOE) Orders:**

- **10 CFR 835, *Occupational Radiation Protection***
- **DOE Order 5400.5, *Radiation Protection of the Public and Environment***
- **DOE Order 5480.11, *Radiation Protection for Occupational Workers***
- **DOE/EH-0256T, DOE *Radiological Control Manual***

1. Supporting Knowledge and/or Skills

a. Discuss the purpose and scope of the regulation and Orders.

b. Discuss the applicability and impact of the listed regulation and Orders on the EH oversight program.

c. Describe the authorities and responsibilities of the EH Resident with respect to the regulation and Orders.

2. Summary

DOE environment, safety and health (EH) residents should be familiar with the various radiological protection regulations and guidelines in order to more effectively provide management oversight and direction to ensure the safe operation of defense nuclear facilities. Their responsibilities generally include verification of environment, safety, and health programs and serving as the EH point-of-contact, the EH resident duty officer, and subject matter/technical expert for site-related activities as assigned.

Since the publication of this competency, DOE Order 5480.11 has been superseded by DOE Notice 441.1. However, Order cancellation does not necessarily mean that the Order is no longer in effect. For example, DOE N 441.1, *Radiological Protection for DOE Activities,* which cancels 5480.11 and three additional radiation protection-related Orders states:

> "Cancellation of an Order does not, by itself, modify or otherwise affect any contractual obligation to comply with such an Order. Canceled Orders that are incorporated by reference in a contract shall remain in effect until the contract is modified to delete the reference to the requirements in the canceled Orders."

The following charts provide summaries of the applicable regulations, DOE Orders, and guidance documents listed in EH resident competency 2.9.

10 CFR 835, *Occupational Radiation Protection*	
Purpose	Implements, within DOE, the radiation protection guidance to Federal agencies for occupational exposure and other radiation protection standards. The standards set forth in this rule help to ensure that DOE facilities are operated in a manner such that occupational radiation exposure to workers is maintained within acceptable limits and as low as reasonably achievable (ALARA).
Scope	DOE facilities
Requirements/ Key Words	Subpart A, General Provisions, establishes radiological protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from DOE activities. Subpart B, Radiation Protection Programs (RPP), includes the plans, schedules, and measures to be taken to comply with all requirements in Part 835. An RPP for each DOE site was due on January 1, 1995, to Headquarters. Subpart C, Standards for Internal and External Exposure, addresses limits for: • General employees (occupationally exposed) • Minors (occupationally exposed) • General public It also addresses: • Planned special exposures • Nonuniform exposure of the skin • Concentrations of radioactive material in the air Subpart D, Reserved Subpart E, Monitoring in the Workplace, addresses: • General requirements • Instrumentation • Individual monitoring - external • Individual monitoring - internal • Area monitoring • Radioactive contamination control and monitoring Subpart F, Entry Control Programs, addresses: • Radiological Areas • High Radiation Areas • Very High Radiation Areas

10 CFR 835, *Occupational Radiation Protection* (cont.)	
Requirements/ Key Words (cont.)	Subpart G, Posting and Labeling, addresses requirements for signs: • DOE-approved signs • Yellow background • Black or magenta radiation symbols • Clear and conspicuous signs and specific posting requirements for: - Controlled Areas - Radiation Areas - High Radiation Areas - Very High Radiation Areas - Airborne Radioactive Areas - Contamination Areas - High Contamination Areas Subpart H, Records, addresses requirements for documenting compliance with Part 835, the RPP, and, in particular, those actions that demonstrate compliance with the ALARA provisions of the rule. Subpart I, Reports to Individuals, requires in part, on an annual basis, each DOE facility or DOE contractor-operated facility to provide each individual monitored for occupational exposure a radiation dose report of his/her occupational exposure at the facility. Subpart J, Radiation Safety Training, requires the training of general employees, radiological workers, and radiological control technicians; verification by examination; intervals of training not to exceed two years; and a provision for acceptance of training from other facilities. Subpart K, Design and Control, addresses added emphasis on facility and equipment design and administrative controls in order to maintain radiological exposures ALARA. Subpart L, Release of Materials and Equipment from Radiological Areas, cannot be removed from controlled areas unless measurements are made to establish that either the total or removable contamination levels do not exceed specified surface radioactivity values. Subpart M, Reserved Subpart N, Accidents and Emergencies, addresses: • Employees who have exceeded dose limits • Emergency exposure guidelines • Nuclear accident dosimetry
DOE Order 5400.5, *Radiation Protection of the Public and the Environment*	
Purpose	Outlines requirements to protect the public and the environment against undue risk of radiation due to operations of DOE and DOE contractor facilities.
Scope	DOE and DOE contractor facilities

DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (cont.)	
Requirements/ Key Words	Chapter I, General Summary DOE is primarily adopting the ICRP 26/30 system of dose calculation, limitation, etc. The DOE primary standard is 100 mrem effective dose equivalent (EDE) in a year above background to members of the public from all pathways and sources. (This is reduced from the previous primary standard of 500 mrem in a year, since it is already largely being achieved and it follows the ICRP recommendation.) Chapter II, Requirements for Radiation Protection of the Public and the Environment The primary limit of 100 mrem EDE in a year is described in detail. The limit includes all pathways and sources and internal and external exposure. It does not include doses received from occupational exposures, naturally occurring background radiation, medical radiation, consumer products, or fallout. If justified, the public dose limit can be temporarily increased to 500 mrem through a request to EH-1. Chapter III, Derived Concentration Guides (DCGs) for Air and Water DCGs are concentrations of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (e.g., ingestion of water), would result in an effective dose equivalent of 100 mrem. These are not limits, but tools to be used in meeting the basic requirements. Chapter IV, Residual Radioactive Material Residual Radioactive Material: • Originally issued as guidance for Formerly Utilized Sites Remedial Action Program (FUSRAP) and Surplus Facilities Management Program (SFMP) • Chapter IV of DOE Order 5400.5 now applies DOE-wide. • Basic dose limit is 100 mrem above background effective dose equivalent in a year due to residual radioactive material. It is expected that the potential doses associated with actual or likely use of the released property will be a few mrem or less. This limit applies to all sources and pathways (excluding background and medical). The limits for radon and radon progeny are addressed separately. • Guidelines for residual radioactive material in soil shall be derived by environmental pathway analysis except for thorium (Th) and radium (Ra). The RESRAD computer program is recommended, but alternate procedures are acceptable.
DOE N 441.1, *Radiological Protection for DOE Activities*	
NOTE:	DOE N 441.1 supersedes DOE N 5400.13, *Sealed Radioactive Source Accountability,* and DOE Order 5480.11, *Radiation Protection for Occupational Workers* Contractors shall be directed to continue to comply with the requirements of orders canceled by this notice until their contracts are modified to delete the reference to the requirements of the canceled orders.
Purpose	Establishes radiological protection program requirements that, combined with 10 CFR 835 and its associated implementation guidance, form the basis for a comprehensive program for protection of individuals from the hazards of ionizing radiation in controlled areas. These requirements shall remain in effect pending completion of the department's rulemaking efforts to codify these or equivalent requirements.

DOE N 441.1, *Radiological Protection for DOE Activities* (cont.)	
Scope	This Notice applies to all defense nuclear facilities classified as hazard categories 1, 2, or 3 that are subject to the requirements of 10 CFR 835, and to contractors that operate defense nuclear facilities.
Requirements/ Key Words	Administrative Control Levels A system of administrative control levels (ACLs) shall be implemented to control radiological worker doses at levels below the occupational exposure limits provided in 10 CFR 835.202. 1. A DOE ACL of 2 rem (0.02 Sv) total effective dose equivalent (TEDE) per year shall be implemented. No individual shall be permitted to receive an occupational exposure during planned activities that would result in exceeding the DOE ACL without the specific written authorization of the cognizant secretarial officer or designee. 2. A cumulative total effective dose equivalent (CTEDE) ACL of 1 rem (0.01 Sv) TEDE per year of age shall be implemented. When a radiological worker's CTEDE exceeds 1 rem TEDE per year of age, special ACLs shall be established during ensuing years as necessary to cause that individual's CTEDE to approach and, if possible, fall below 1 rem per year of age. 3. A facility-specific ACL shall be approved each year by facility management to maintain radiological worker doses below the DOE ACL. Written authorization by facility management shall be required prior to allowing any radiological worker's dose resulting from planned activities to exceed the facility-specific ACL. Work Authorizations Authorizations to work in radiological areas shall be in accordance with the radiological protection program (RPP) required by 10 CFR 835.101. This program, in part, shall describe a radiological work authorization program as specified in 835.501 that appropriately utilizes available work documents and procedures. The level of detail included in these documents shall be commensurate with the nature and magnitude of the hazard and complexity of the required controls. Radiation Safety Training 1. Radiation safety training for general employees, radiological workers, and radiological control technicians shall utilize those portions of the standardized core training materials published by DOE that are relevant to facility hazards and operations, augmented as necessary by site-specific materials. Documentation of satisfactory completion of the entire DOE standardized core course(s) shall be accepted by all DOE activities. 2. Training requirements commensurate with the hazard within a posted area shall be completed by an individual prior to permitting unescorted access to that area.

DOE N 441.1, *Radiological Protection for DOE Activities* (cont.)	
Requirements/ Key Words (cont.)	Posting Any accessible area in which radioactive material is used, handled, or stored shall be posted with the words "Caution, Radioactive Material." The posting shall meet the requirements of 10 CFR 835.601. The following areas are exempt from this posting requirement: 1. Areas containing 10 or fewer sealed radioactive sources with activities below the accountability criteria established in Attachment 1, Values for Exemption of Sealed Radioactive Sources from Inventory and Source Integrity Tests. 2. Areas containing only materials that are properly packaged and labeled for transport in conformance with Department of Transportation regulations or corresponding DOE directives, and that are expected to enter into transportation in the immediate future (i.e., the current shift). 3. Areas under continuous observation and control of an individual knowledgeable of and empowered to implement required access control measures. 4. Areas posted as a radiological area in accordance with 10 CFR 835.603. 5. Other areas posted with radiological warning signs meeting the criteria established in 10 CFR 835.601. 6. Areas containing radioactive materials in quantities below the site- or facility-specified posting threshold. This threshold shall be established at a level below that which is likely to cause any individual to receive a TEDE in excess of 0.1 rem in a year. Control of Sealed Radioactive Sources 1. Administrative procedures shall be developed and maintained to control sealed radioactive sources having values equal to or exceeding those in Attachment 1, Values for Exemption of Sealed Radioactive Sources from Inventory and Source Integrity Tests. 2. Accountable sealed radioactive sources or their storage containers or devices shall be labeled with the standard radiation warning trefoil and the words, "Caution, Radioactive Material." 3. An individual shall be designated to maintain control of assigned accountable sealed radioactive sources. Prior to being designated, the individual selected shall be trained as a radiological worker in accordance with 10 CFR 835.902 and instructed on site-specific source control procedures. 4. Each accountable sealed radioactive source shall be inventoried at intervals not to exceed six months. A two-month grace period may be used to accommodate scheduling needs. This inventory shall establish: • The physical location of each accountable sealed radioactive source. • The adequacy of associated postings and labels. • The adequacy of storage locations, containers, and devices.

DOE N 441.1, *Radiological Protection for DOE Activities* (cont.)	
Requirements/ Key Words (cont.)	Control of Sealed Radioactive Sources (cont.) 5. Each accountable sealed radioactive source having an activity exceeding 0.005 μCi shall be subject to a source integrity test upon receipt, when damage is suspected, and at intervals not to exceed six months. A six-week grace period may be used to accommodate scheduling needs. Source integrity tests shall be capable of detecting radioactive material leakage equal to or exceeding 0.005 μCi. 6. Notwithstanding the requirements of paragraph 6.e.(5), an accountable sealed radioactive source is not subject to a periodic source integrity test if that source has been documented to have been removed from service. Such sources shall be stored in a controlled location, subject to periodic inventory as required by paragraph 6.e.(4) of this section, and subject to a source integrity test prior to being returned to service. 7. Notwithstanding the requirements of paragraph 6.e.(4) and 6.e.(5), an accountable sealed radioactive source is not subject to periodic inventory and source integrity tests if that source is located in an area that is inaccessible to individuals due to operational or environmental constraints. 8. An accountable sealed radioactive source found to be leaking radioactive material at a level exceeding 0.005 μCi shall be controlled in a manner that prevents the escape of radioactive material to the workplace. Exposure of Minors The exposure of minors during direct onsite access to a DOE site or facility shall be controlled such that the dose to the extremities, lens of the eye, and other organs and tissues does not exceed 10% of the corresponding occupational exposure limits established in 10 CFR 835.202. Appropriate monitoring of external and internal dose shall be performed to demonstrate compliance with these limits. DOE Laboratory Accreditation Program (DOELAP) DOELAP shall be maintained consistent with the applicable DOE standards, and dosimetry programs shall be accredited at periodic intervals consistent with the standards. Additional guidance for the various program elements are contained in the DOELAP Technical Standard.

DOE/EH-0256T (Revision 1), *Radiological Control Manual*	
Purpose	**NOTE:** The DOE *Radiological Control Manual* was initially issued as a regulation document for all DOE facilities to follow with respect to radiation protection. It is now considered a guidance document and is in the process of being revised. Establish and maintain a system of regulatory policy and guidance reflective of national and international radiation protection standards and recommendations. Ensure that personnel responsible for performing radiological work activities are appropriately trained. Ensure the technical competence of personnel responsible for implementing and overseeing the radiological controls program. Establish and maintain, from the lowest to the highest levels, line management involvement and accountability for departmental radiological performance. Ensure that radiological measurements, analyses, worker monitoring results, and estimates of public exposures are accurate and appropriately made. Conduct radiological operations in a manner that controls the spread of radioactive materials, reduces exposure to the workforce and the general public, and utilizes a process which seeks exposure levels as low as reasonably achievable. Incorporate dose reduction, contamination reduction, and waste minimization features into the design of new facilities and significant modifications to existing facilities in the earliest planning stages. Conduct oversight to ensure that departmental requirements are being complied with and that appropriate radiological work practices are being implemented.
Scope	All Departmental elements
Requirements/ Key Words	Chapter 1 Excellence in Radiological Control Chapter 2 Radiological Standards Chapter 3 Conduct of Radiological Work Chapter 4 Radioactive Materials Chapter 5 Radiological Health Support Operations Chapter 6 Training and Qualification Chapter 7 Records

3. Self-Study Scenarios/Activities and Solutions

Review

- 10 CFR 835, *Occupational Radiation Protection*
- DOE Order 5400.5, *Radiation Protection of the Public and Environment*
- DOE N 441.1, *Radiological Protection for DOE Activities* (supersedes DOE Orders 5400.13, 5480.11, and 5480.15)
- DOE/EH-0256T (Revision 1), *Radiological Control Manual*

Action or situations were used to create a new incidents for the following scenarios from these references:

- *Operating Experience Weekly Summary 96*-10, March 1 through 7, 1996, Event Number 4.
- *Operating Experience Weekly Summary 96*-20, May 10 through 16, 1996, Event Number 4.

The following activities require analyzing a short scenario to identify issues and determine the appropriate reference to consult for guidance and requirements.

Activity 1

A worker left the site with alpha contamination on his personal clothing. Radiological control technicians surveyed the employee's home and detected alpha contamination of 1,200 dpm on a shoe and 300 dpm on a pants leg. The technicians also surveyed the employee's automobile and areas where he traveled after leaving work. They found no other contamination.

What is the issue in this scenario and what specific section(s) in the listed references address the issue?

Your Solution:

Activity 1, Solution
(Any reasonable paraphrase of the following is acceptable.)

The scenario described an incidence of contamination carried offsite.

DOE 5400.5, *Radiation Protection of the Public and the Environment* and 10 CFR 835, *Occupational Radiation Protection,* provide limits for public and qualified worker exposure and contamination. The radiation protection standards and program requirements established by DOE Order 5480.11, *Radiation Protection for Occupational Workers,* have been codified by 10 CFR 835 and violations can incur fines or other penalties.

DOE/EH-0256T(Revision 1), *Radiological Control Manual*, identifies controls and techniques to preclude the spread of contamination. Chapter 1, Excellence in Radiological Control, provides guidance in establishment and maintenance of control programs.

Activity 2

Operators conducting a tour in a contaminated area saw a member of the tour group remove her outer and inner anti-contamination (anti-C) gloves from one hand to correct a contact lens problem. The tour group members were dressed in anti-C clothing, but were not wearing hoods or respirators. An escort directed a radiological control technician (RCT) to survey the visitor's hand. The technician detected no contamination and the tour continued. Afterwards, the facility manager counseled the visitor and directed a complete radiological survey. The visitor could have contaminated their face, eyes, personal clothing, and spread contamination throughout the facility.

What is the issue in this scenario and what specific section(s) in the listed references address the issue?

Your Solution:

Activity 2, Solution
(Any reasonable paraphrase of the following is acceptable.)

The scenario described a situation where the visitor to the site did not practice acceptable basic radiological procedures; therefore, the visitor may not have been trained or briefed on appropriate basic radiation concepts.

DOE/EH-0256T (Revision 1), *Radiological Control Manual*, provides guidance for training visitors. Specifically, Sections 622, Radiological Orientation of Visitors, and Section 657, Specialized Visitor Training for Tour Groups and Visiting Dignitaries, Scientists, and Specialists, identifies training for visitors and tour groups including basic radiation protection concepts.

Activity 3

An employee checking a sealed 10 mCi americium-241 (Am-241) source for leaks was internally contaminated when he inhaled Am-241 oxide powder.

What is the issue in this scenario and which specific section(s) in the listed references address the issue?

Your Solution:

Activity 3, Solution

The scenario described an example of the importance of exercising care when handling sealed sources of radiation.

DOE N 441.1, *Radiological Protection for DOE Activities*, Section 6.e., describes how to control and maintain accountability of sealed radioactive sources. It also specifies requirements for receipt, inventory, storage, transfer, disposal, and integrity testing of radioactive sources.

DOE/EH-256T (Revision 1), *Radiological Control Manual,* Article 431, requires control and accountability of sealed radioactive sources.

4. Suggested Additional Readings and/or Courses

Readings

- Argonne National Laboratory. (1988). *Department of Energy Operational Health Physics Training* (ANL-88-26). Argonne, IL: Author.
- Cember, Herman (1996). *Introduction to Health Physics* (3rd ed.). McGraw-Hill: New York.
- DOE Order 6430.1A, Referenced Documents Index, p. 17-35.
- Gollnick, D. A. (1988). *Basic Radiation Protection Technology* (2nd ed.), Pacific Radiation Corporation: Altadena, CA.

Courses

NOTE: See Appendix B for additional course information

- DOE/EH-0450 (Revision 0), *Radiological Assessors Training (for Auditors and Inspectors) - Applied Radiological Control*, sponsored by the Office of Defense Programs, DOE

NOTES: